

*Reprinted from the New York Medical Journal
for June 7, 1897.*



THE TREATMENT OF WHITE SWELLING OF THE KNEE.

By A. B. JUDSON, M.D.,

ORTHOPAEIC SURGEON TO THE CITY AND COUNTY HOSPITAL OF THE NEW YORK
HOSPITAL.

AS every-day incident in surgical practice is fixation or the prevention of motion between the members of a joint, or between the fragments of a broken bone. The readiest method is the use of a restrictive splint of suitable size and inflexibility, which is bound to the bone above and below the level of motion—a method almost useless in a case in which the hip joint is to be fixed, because the shortness of the distance from the joint to the upper border of the pelvis denies to the splint that leverage which is necessary before it can have the power to restrain the motion of the joint. A common toy, the cup and ball, may be used as an illustration. Let us try to prevent motion of the ball in the cup (revolution through, we will say, 45° on an axis at right angles with the handle of the cup) by restrictive splints. It is clearly impracticable. But, if we drive a peg, six or eight inches long, into a hole in the ball, fixation is easily effected by retentive splints, bandaged above to the peg, and below to the handle of the cup. The hip joint may be fixed with a reasonable degree of stability by the use of traction—a resort which is unnecessary when the knee is to be

fixed, because the long members of this joint, the femur and the tibia, give to retentive splints a mechanical advantage which enables them to exert a fixative power. And, as the knee presents a ginglymoid articulation, with very slight lateral motion, it follows that the simplest form of retentive splint is sufficient.

Such a splint needs to make but four points of resistance, or retentive pressure—two from before backward, near the level of the joint (as shown at C and D in Fig. 1), and two from behind forward—one at the upper part of the thigh, at B, and the other at the lower part of the leg, at A.

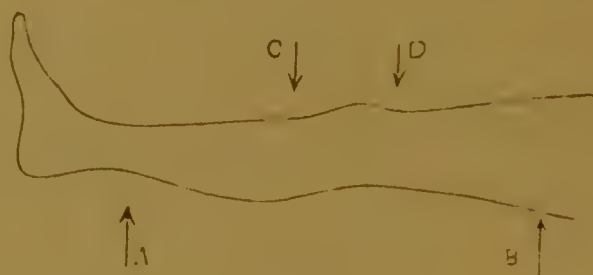


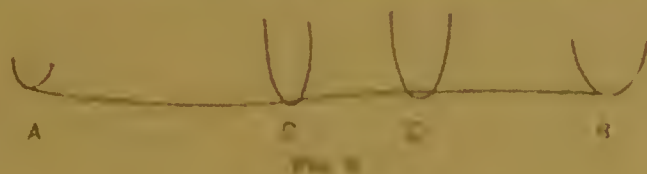
FIG. 1.

It will be recalled that the plaster-of-Paris splint, applied to arrest motion in the knee joint, accomplishes its purpose by making pressure only in the vicinity of the points indicated, although the material is spread over the entire limb.

A splint constructed on this plan may be conveniently made of a posterior upright extending from the upper part of the thigh to the lower part of the leg (as shown at B A in Fig. 2), and four cross-pieces, each in the shape of the letter U, and firmly attached to the upright one at its upper end, B, one at its lower end, A, one a short distance above the level of the joint, at D, and the fourth a short distance below this level, at C.

The two middle cross-pieces, C and D, should be applied

to the lower or posterior side of the upright. When thus arranged, the rivets are less exposed to the chance of breaking. The upper and lower cross-pieces, B and A, should be applied to the upper or anterior side of the upright. They may each, A and B, be provided, although this is not



essential, with a single buckle and a piece of webbing, while the two middle pieces, C and D, should each have two strong buckles, one at each end, and a piece of webbing passed through a sliding pulley, so that the webbing may be moved along as it is worn through by the teeth of the buckles. These two pieces of webbing, spanning the front of the limb above and below the joint, may be considered the key of the apparatus, because the fixation of the joint is practically perfect when they are tight, relaxed when they are loosened, and withdrawn when they are removed.

The upper and lower pieces, A and B, are to be made of light and narrow bar steel wound with some soft material. The efficiency of the splint depends in great measure on the close apposition with which these pieces are applied to the shaft of the femur and the bones of the leg. A narrow piece of steel scantly padded displaces the soft parts and fluids and closely approaches the bone, and yet, if watchfully applied, it will not interfere with the comfort and integrity of the skin. On the other hand, broad surfaces, such as are found in the interior of a plaster splint, are prevented, by the interposition of the soft parts, from approaching the bone and producing the desired fixation of the joint. It may be an exaggeration, but it conveys the idea, to say that

a plaster-of-Paris or silicate splint applied to the thigh contains a mass of jelly in which the femur is but little restrained from motion.

While the upper and lower cross-pieces should be thus carefully padded, the two middle pieces, C and D, may be left uncovered, as they do not touch the skin, or at least make no pressure on it. They, as well as the upright, should, however, be made strong and practically inflexible, as they bear the strain of the two pieces of webbing which cross the front of the limb. It is of importance that the steel be annealed or softened, so that the shape of the upright and cross-pieces may be changed by the use of a vise and wrench. The upright especially should be tractable, because, applied crooked to a flexed limb, it is to be gradually straightened, as the limb straightens in obedience to the pressure and counter-pressure which are brought to bear by tightening the webbing which crosses the front of the limb. It is necessary, also, to be able to change the length and shape of the cross-pieces and their points of attachment on the upright, as it is impossible to measure a limb with such nicety as to secure a splint which shall not only answer the purpose at the first application, but also meet the changing requirements of a ease of white swelling of the knee in a growing child. With soft steel and a few tools it is not impossible for even the "busy practitioner" to give such a patient comfort and the assurance of recovery with the apparatus here described.

In some cases the splint will slip down until the webbing which passes above the line of the joint presses in an uncomfortable way upon the knee. This may be prevented by a piece of gum plaster applied without a roller to the middle of the posterior surface of the thigh or leg, and ending in a piece of webbing which passes around the cross-piece next below to be attached to a buckle on the upright.

For elegance and cleanliness the different parts of the splint may be wound with gum plaster to prevent rust, and then with cotton flannel, which may be renewed, at home if desirable, when it becomes worn or soiled.

I have used apparatus constructed in the manner above described in the treatment of white swelling of the knee in a large number of cases, and always with good results and with confidence that the fixation thus secured has in every case hastened recovery.

Rational grounds for the employment of fixation in these cases are found in a repetition of the statement that the disease is inflammatory in character, and that an arrest of function is the first step toward an arrest of the inflammation. The presence of inflammatory action in the bones of a deeply seated joint is not easily appreciated. Pain, which is so urgent a symptom when the nerves of the surface are involved in inflammation, is for long periods of time absent, and the affected structures are remote from the surface and hidden from direct examination by integumentary and other tissues in a perfectly healthy condition. It is important, however, to bear in mind that we are, when dealing with a case of this kind, in the presence of a morbid condition, to which the late Dr. Gross referred in the following impressive words: "A thorough knowledge of inflammation is indispensable to every practitioner of surgery. It should form the principal subject of his studies during his pupillage, and the main object of his professional contemplation in after-life."* Let us ask, What are the signs of inflammation? Pain, swelling, heat, redness, and impairment of function. These are all clinical signs of joint disease, excepting redness, which appears on dissection. What are present in inflammation? Increased vascular action, softening, and dis-

* "A System of Surgery." By Samuel D. Gross, M. D. Second edition, 1892, vol. i, p. 54.

integration. These are accompaniments of joint disease. What are the products of inflammation? Serum, pus, and plastic lymph. These are produced by joint disease. And what are the results of inflammation? Effusion, ulceration, suppuration, exudation, adhesion, and contraction. These are the familiar results of joint disease.

Having thus been led to an appreciation of the fact that articular osteitis, as its name implies, is essentially an inflammatory affection, we inquire whether the methods used with success in the treatment of inflammation in general are adapted to the treatment of this form. In general medicine and surgery the presence of inflammation demands, in the first place, the arrest of function. Instances are numerous. In ophthalmia, disuse of the affected organ and the exclusion of light are demanded. Opium secures arrest of function and invites resolution in the inflammations of the peritonæum and intestines. Cystotomy precludes the activity of the inflamed bladder. The pain of acute pleurisy is obviated by adhesive straps surrounding the chest and limiting its expansion. The distress of laryngeal phthisis is allayed by tracheotomy, which relieves the diseased larynx from duty.* The recent remarkable success attending the management of surgical and other wounds is largely due, apparently, to the fact that the method adopted arrests the function of the wounded parts, and thus confines inflammation within benign and plastic limits. Citations by the score or hundred might be made in surgical and medical practice of inflammatory conditions relieved or removed by the arrest of the function of the affected part.

* The impossibility of stopping the action of the lungs is doubtless one of the causes of the incurability of phthisis pulmonalis. Were it possible to temporarily occlude the bronchus of the affected lung, it is not altogether fanciful to suppose that in a favorable case the result might be circumscribed pleuritic adhesion, followed by evacuation and cicatrization, as in articular osteitis.

In the application of this precept to the treatment of articular osteitis we encounter at once the fear of ankylosis, or ankylophobia, to borrow a term from the French.* I am aware that here we have found an objection which, to a certain extent, rules in the minds of surgeons and inclines them to oppose the fixation of a diseased joint—an objection which is not in accord, however, with the following considerations: *First*, the prolonged fixation or disuse of a joint can not produce ankylosis, provided the joint is free from disease. Such treatment of a healthy joint will be followed, of course, by stiffness and pain when wide motion is attempted, but this condition yields completely to persistent effort on the part of the patient, with or without the assistance of the surgeon, and is very different from ankylosis, which implies the locking up of the joint in the ultimate products of inflammation when cicatricial tissue, structurally shortened ligaments, and altered articular surfaces combine to form a permanent resistance to motion. *Secondly*, the ankylosis which follows joint disease, being caused by the presence of the final products of inflammation, is best prevented, and its extent limited, by removing or reducing the inflammation, and this requires, as the condition of prime importance, arrest of function. *Thirdly*, fixation applied to an inflamed joint will, so far as the joint is free from disease, be powerless to add to the degree of ultimate ankylosis, and, so far as the joint is diseased, it will diminish ultimate ankylosis by arresting the inflammation and preventing an excess of its products. On these premises, which seem to me sound, we are required to apply thorough fixation in the treatment of articular osteitis.

* "Depuis longtemps, dans ma pratique et dans mon enseignement, je combats de toutes mes forces cette *ankylophobie* et la *mobilisation préventive* qui en est la conséquence." Vernieuil, "Bull. et mém. de la soc. de chin. de Paris," June 4, 1879, pp. 487, 488.

A few years ago I reviewed a number of published reports of pathological appearances in hip disease, especially in the early and middle stages, and found that the specimens bore no traces of the injury said to be caused by reflex muscular action. In a paper written on the subject the absence of this evidence was cited as an indication that in the treatment of this affection it is useless to seek to counteract directly and mechanically the muscles surrounding the joint. Incidentally it was observed that the condition of the bone called for arrest of motion. Ten cases were cited in which the specimens had been described with more or less minuteness (some of the descriptions being accompanied by wood-cuts), and the precept that it is useless to attempt counteraction of the muscles was abundantly confirmed at every step.* Let us rapidly reconsider these cases to see whether or not their pathological features support as well the other precept that fixation is the proper treatment. In the first case, that of Fricke, there were increased redness and vascularity of the spongy tissue, and redness of every part of the synovial membranes, the greater portion of the neck of the femur being converted into a yellowish or grayish white mass; in the second case, Volkmann's, there was a cavity in the neck lined with tuberculous membrane and filled with cheesy matter; in the third case, that of Lannelongne, portions of the synovial membrane were red, thick, and fungous, and there were redness of the spongy tissue of the neck and center of ossification of the head, and a cavity filled with a cheesy substance below the epiphyseal cartilage; in the fourth case, that of Holmes, there was a deep carious cavity in the neck with necrosed bone at the bottom, the joint being full of pus; † in the fifth case, Barwell's, there

* "New York Medical Journal," July, 1882, pp. 1-17.

† There is a beautifully prepared counterpart of this specimen in the collection of Dr. L. S. Pilcher, of Brooklyn.

was a carious excavation filled with pus, bony detritus, and soft granulation tissue, the articular cartilage being detached from the bone to a considerable extent; in the sixth case, Hodges's, the head had almost disappeared, the cartilage remaining attached to the neck by periosteum on the under surface; in the seventh case, Poore's, there was central osteitis which had involved the external shell of the bone at a single point, where it had destroyed, to a small extent, the articular cartilage on the upper surface of the head; in the eighth case, Gibney's, there were three points of central osteitis, the head of the femur presenting a dirty yellowish aspect, its cartilage being traversed by grooves; in the ninth case, the second from Volkmann, there was "shedding" of the articular cartilage, large cap-like portions being loosened and detached; and in the tenth case, Sayre's, the whole upper portion of the femur was diseased and denuded.

For the relief of these morbid conditions, it appears to me impossible to say that motion is required or admissible. It is also impossible for me to understand how motion, in whatever manner effected, would, if enforced earlier, have prevented the development of the results of inflammation described in these cases.

The foregoing remarks referring directly to hip disease, which may be considered the type, and, on account of certain obvious mechanical peculiarities, the most intractable manifestation of articular osteitis, are equally applicable to disease of the knee in the treatment of which fixation is secured with comparatively little difficulty by means of the simple apparatus above described.

But fixation is not all that can be secured by mechanical means in this disease. The function of motion is thus arrested, but there is another function still more important in its bearing on pathology and therapeutics—the duty of sup-

porting weight and enduring concussion. The structures of the joint are designed not only to permit motion between its parts, but also to sustain the weight of the body in standing, walking, and running. And, when the organ is the seat of inflammation, arrest should take effect not only on the function of motion, but also on the weight-bearing function.

At the first glance it is evident that the performance of the latter function is a most serious thing for the diseased joint in view of the weight of the body and the violence attending its sudden and rapid locomotion. And this first impression is confirmed by the fact that the upper extremities, which are exempt from the duties of sustaining weight and enduring concussion by reason of being pendant in standing and walking, are found to be comparatively free from the ravage of destructive joint disease. Articular osteitis is found, of course, in the upper extremity, but this disease in the shoulder, elbow, and wrist seldom has the tedious and destructive career which is called to mind by the use of the terms "hip-disease," "white swelling of the knee," and "pulpy disease of the ankle."

How do these diseases figure in the records of our orthopædic institutions? In the New York Institution for the Relief of the Ruptured and Crippled,* and the New York Orthopædic Dispensary and Hospital,† during the last year (ending September 30, 1885), cases of disease of the larger joints of the extremities were treated in the following proportions, the figures representing the aggregate number treated at the two institutions:

Cases of disease of the hip.	564
" " shoulder.	9
" " knee	258
" " elbow	10

* "Twenty-second Annual Report," p. 13.

† "Eighteenth Annual Report," Table No. II.

Cases of disease of the ankle.	59
" " wrist	26
" " larger joints of the lower extremity. . .	881
" " larger joints of the upper extremity. .	89

These figures may be understood as approximately expressing the comparative immunity of the upper extremities from destructive joint-disease. To a certain extent they prove and give a remarkable emphasis to the statement that pressure and concussion are of the utmost importance in articular osteitis.*

It is not to be denied that the joints of the lower extremities are to a certain degree protected from the ill effects of pressure and concussion by the angles and curves which the skeleton forms in the changing attitudes of the body as well as by the elasticity of the tissues and the conservative action of the muscles. The arrangements for protection are indeed admirable. They defend the diseased bones and joints from those signally disastrous effects which might be anticipated from a consideration of the great weight of the body and the extreme violence of the concussions which attend active locomotion. But it is clear that they can not guarantee the immunity enjoyed by the joints of the upper extremity, which are subject to no pressure whatever in standing, and receive, in an insignificant degree, the concussions which attend locomotion.

The very existence of an elaborate system for protection reminds us of the fact that the great weight of the body, whether standing quietly or in violent activity, must,

* It is an interesting question, beyond the limits of this paper, whether non-articular osteitis is more frequent in the lower than in the upper extremity, and whether in cases of this kind, also, pendancy of the limb is not an important therapeutic consideration.

after all, be sustained by the bones and joints of the lower extremities. The muscular action developed for protection implies in itself force expended on bone and joint. The pressure and jar are modified and distributed, but they can not be abolished.

Since, then, Nature has not been able to throw the weight of the body upon the bones and joints of the lower extremities, and at the same time render them exempt from violence, mechanical surgery can hardly be expected to solve this difficult problem, made still more difficult by the presence of the pain, softening, and reflex muscular action which come in with disease. While admiring the ingenuity of those who, following the lead of Dr. Henry G. Davis, would interpose the elastic quality of India-rubber between a diseased joint and the ill effects of standing and walking, I can not but think that a better way to attain this object is to convert the affected limb into a pendent member, so that Nature, in her efforts to repair a diseased hip, knee, or ankle, may have the mechanical advantage which she uses to such good purpose when a joint of the upper extremity is threatened with destructive disease.

In the treatment of articular osteitis of the knee, a convenient method of suspending the limb while the patient is erect is to use Mr. Thomas's splint, which is fully described in his book.* This apparatus furnishes a serviceable and tolerably comfortable pelvic crutch. With the addition of a high sole on the well foot, a patient thus equipped is able to attend to the ordinary affairs of life while the affected limb is suspended, or, at the most, touching the ground lightly with the anterior part of the foot. I have found it convenient to construct the upright of this apparatus of bar steel, having the inner piece, which bears the weight of the

* "Diseases of the Hip, Knee, and Ankle," Hugh Owen Thomas, Liverpool, England, 1875.

body, stronger than the outer, the chief use of which is to support the outer extremity of the oval ring. Each upright is adjustable in length by being in two pieces, which overlap and are fastened together with screws. The inner upright is usually worn about two inches shorter than the outer. The foot-piece is shod with a piece of sole-leather, fastened with two screws, counter-bunk on the inner side of the steel—an inexpensive method, by the way, of shodding the hip splint. Instead of the leather apron and the bandages of Mr. Thomas's splint, I surround the limb and the splint with a webbing strap at the middle of the thigh, and a leather strap above the ankle.

I have found that it is easy to make the oval ring too large and to have too much padding on it. A small ring will keep its place under the ischiatric tuberosity, and this bony process will more easily surround and maintain its place on a small and compact pad than on a large and soft one.

This splint is to be applied over the fixative splint above described, and is to be removed when the patient retires, while the fixative splint is to be worn day and night. Mr. Thomas's splint is designed to fix the knee joint as well as to act as a crutch. I have found it better to assign each of these functions to a separate piece, believing that fixation can thus be more firmly and accurately maintained, while the inconvenience of wearing Thomas's splint at night is avoided.

The object in view in the use of the above-described apparatus is to restore the affected organ to health with as little impairment of function as possible. The retention or restoration of mobility is sought and sometimes found. If, however, ankylosis is the result, it is important that it should be in the straight position. If flexed, the supporting power of the limb is weakened by the presence of an axial angle which

throws a harmful strain on the ligaments. If straight, the weight is borne by a linear column of bone. Even if the posterior subluxation of the tibia on the femur* is not entirely reduced, allowing the axis of the tibia, when the limb is fully extended, to lie a trifle behind that of the femur, the supporting power of the entire column is not seriously impaired. And, when the patient is freed from treatment and walks with a stiff knee, the gait is susceptible of great improvement by an extremely simple and inexpensive device. It will be evident on observation that the chief defect in walking with a stiff knee arises from an elevation of the pelvis on the affected side at every step, in order that the foot may be slightly raised from the ground as the limb swings forward. Ordinarily the foot clears the ground as it swings forward by a slight flexion of the knee. If, however, the knee is stiff, the same effect may be produced by removing the heel of the shoe and increasing the height of the heel of the well side. This will, of course, necessitate a greater degree of flexion in the well knee when that limb swings forward in its turn, but this compensation is not attended with inconvenience, and is always made unconsciously whenever we strike a sidewalk which is considerably inclined from side to side.

When we have, by the means above described, relieved pain, reduced the deformity, protected the joint from motion and violence, and equipped the patient for active locomotion, we have given our patient what I conceive to be the greatest benefit which the present state of our science permits in cases of this kind. We have, of course, fallen short of what is done for the relief of many other surgical dis-

* Subluxation is clearly the result chiefly of enlargement of the lower extremity of the femur, another result of which is seen in the lengthening of the affected limb. Contraction of the extensors and the presence of the lateral ligaments are secondary causes of this deformity.

cases in which operative procedures hasten recovery and are even necessary before restoration to health is possible. Our achievements may, to the general or operative surgeon, appear dull and prosaic. They are not directly curative or followed by immediate recovery. They simply place the part and system in the most favorable position for the action of the restorative processes of Nature. In the majority of cases of articular osteitis, even if entirely neglected or exposed to harmful treatment, the time comes when the progressive and destructive processes give way to those of resolution and repair. Though it may not be in the power of either operative interference or mechanical treatment to *precipitate* this favorable change, it is, in my opinion, possible in every case presenting the ordinary features to hasten recovery and greatly benefit the patient by the means indicated in the preceding pages, the value of which is illustrated by the following case:

The patient was a boy of good family history and six years old. He was first seen in April, 1878; was thin and pale from the pain and prostration of inflammation of the left knee of five and a half months' duration. The knee was greatly swollen and its motion very limited, with signs of approaching abscess on the inner side. A fixative splint with a single posterior upright, and Thomas's splint, with a high sole on the well foot, were at once applied, and in a few days the patient was free from pain and active on his feet, racing, wrestling, and taking part in all the joys and sorrows of a boy of his age. His general health rapidly improved. Five months after the splints were applied the abscess opened spontaneously and without pain above the inner condyle of the femur, and discharged freely for four months without affecting the general health, four fragments of cancellous bone being at intervals expelled from the sinus. One month after the discharge ceased all signs of

inflammation had disappeared and the fixative splint was removed so that motion could return, while the part was still protected from injury in walking by the Thomas splint and high sole, which were worn during the day for two months longer, when they were finally removed one year after treatment was begun. At that time the knee was almost as flexible as the well knee. When treatment was begun, the affected limb from the iliac spine to the inner malleolus was half an inch longer than its fellow, and when treatment was suspended it was three quarters of an inch longer, careful measurement placing the lengthening in the femur. Three months after treatment was suspended the knee could be flexed till the heel was half an inch from the buttock. In walking, the gait was perfect, but running developed a slight lameness. There was still considerable muscular atrophy. In September, 1885, six years and a half after treatment was suspended, the lengthening was still three eighths of an inch, and the limb measured in circumference half an inch in the thigh and a quarter of an inch in the leg less than its fellow. These measurements, and a scar one inch and a quarter by one inch, depressed and attached to the deep fascia, were the only physical evidences that the boy had ever suffered from articular osteitis. The knees were equally flexible, and the boy was free from the slightest defect or disability in locomotion. I could relate other cases of similar import, but one example is sufficient.

Conclusions.—White swelling or articular osteitis of the knee is an inflammatory affection attended by destruction and degeneration, and followed, as a rule, by impairment of function. Its severity and duration are increased by use of the joint, and also by an impairment of the general health, which is reciprocally affected by the local disease. It has, however, a so-called natural cure, which occurs when the morbid process is supplanted by the reparative,

The object of treatment is to prevent ultimate impairment of function and to hasten the "natural cure" by improving the general condition and removing causes of local aggravation. Function is to be preserved or restored by subduing inflammatory action. The health is to be maintained by appropriate medication, an observance of hygiene rules, and a proper amount of out-door exercise. Mechanical means should be adopted to secure activity in walking without injury to the affected part.

Locally, fixation of the joint is suggested by the weakening and loss of the hard osseous of the joint and by the presence of hyperæmia, and enforced by the general rule that inflammation should be treated by arrest of function. The affected part should also be prevented from bearing the weight of the body, a precept which is suggested by the softened and excavated state of the bone and the infrequent occurrence of the disease in joints which are exempt from this duty and enforced by the same general rule that the presence of inflammation demands an arrest of function.

Fixation is conveniently secured and deformity reduced by a simple retentive splint, making pressure from before backward in the vicinity of the joint, and from behind forward at the upper part of the thigh and lower part of the leg. Arrest of the weight-bearing function, or protection from violence in standing and walking, is to be secured by suspension of the limb, which is conveniently effected by Thomas's ischiatic crutch, with a high sole on the foot of the unaffected limb.

